

WHAT IS CLAIMED:

1. A reorder engine for reordering, on a per-entity basis, out-of-order data items, the reorder engine comprising:  
  
a pipeline including a plurality of pipeline stages that together simultaneously operate on the data items; and  
  
per-entity context memories operatively coupled to the pipeline stages, the per-entity context memories storing information relating to a state of reordering for each of the entities, the pipeline stages reading from and updating the context memories based on the entity of the data item being processed.
2. The reorder engine of claim 1, wherein the entities are connected to the reorder engine via a switch fabric.
3. The reorder engine of claim 1, wherein the data items are cells and wherein a plurality of cells comprise a packet.
4. The reorder engine of claim 1, wherein the pipeline stages include:  
  
at least one arbitration stage that determines an active entity to process;  
  
and  
  
an address computation stage that calculates a position of a data item associated with a particular one of the entities relative to other data items associated with the particular entity based on a sequence number of the data item.

5. The reorder engine of claim 4, wherein the position of the received data item is calculated based on a modulo operation of the sequence number with a size of a reorder buffer of the particular entity.

6. The reorder engine of claim 4, wherein the pipeline stages further include:

at least one stage configured to an assembly memory with information identifying a correct order of the data items on a per-entity basis.

7. The reorder engine of claim 1, wherein the per-entity context memories include:

a reorder buffer associated with each of the entities, the reorder buffer storing information relating to the received data items.

8. The reorder engine of claim 7, wherein the reorder buffer is implemented as a circular memory.

9. The reorder engine of claim 8, wherein the per-entity context memories further include:

a pointer to each of the reorder buffers that references the rear-most entry in the reorder buffer.

10. The reorder engine of claim 9, wherein the per-entity context memories further include:

a valid bit array associated with each of the reorder buffers, the valid bit array indicating whether entries in the reorder buffer are valid.

11. The reorder engine of claim 8, wherein the per-entity context memories further include:

per-entity notification assembly memories configured to store addresses of the received data items in a correct order of the data items.

12. A method of reordering data items comprising:  
receiving the data items associated with a plurality of entities;  
inputting the received data items into a pipelined reorder engine; and  
sequentially forwarding each of the input data items through stages of the pipelined reorder engine that reorders the received data items on a per-entity basis to correspond to a transmitting order of the data items.

13. The method of claim 12, wherein the stages of the pipeline perform functions including:

determining which of the received data items to process based on an entity that transmitted the data item.

14. The method of claim 13, wherein the stages of the pipeline perform functions including:

calculating a position of a particular one of the data items relative to other data items from the same entity based on a sequence number of the particular one of the data items.

15. The method of claim 14, wherein the stages of the pipeline perform functions including:

updating a memory with addresses of the received data items in a correct order of the data items on a per-entity basis.

16. The method of claim 12, wherein the entities are connected to the reorder engine via a switch fabric.

17. The method of claim 12, wherein the data items are cells and wherein a plurality of cells comprise a packet.

18. A network device comprising:

a data transmission component; and

a plurality of processing elements connected by the data transmission component, the processing elements communicating with one another by transmitting data items over the data transmission component, the processing elements each including a reorder engine configured to arrange received data

items into an order corresponding to an order in which the data items were transmitted, each of the reorder engines including:

a pipeline having a plurality of pipeline stages that together simultaneously operate on the received data items to arrange the data items into the order corresponding to the order in which the data items were transmitted.

19. The network device of claim 18, wherein each of the reorder engines further includes:

per-entity context memories operatively coupled to the pipeline stages, the per-entity context memories storing information relating to a state of reordering for each of the entities, the pipeline stages reading from and updating the per-entity context memories based on an entity associated with the data item being processed.

20. The network device of claim 19, wherein the per-entity context memories include:

a reorder buffer associated with each of the processing elements, the reorder buffer storing information relating to the received data items.

21. The network device of claim 20, wherein the per-entity context memories further include:

a pointer to each of the reorder buffers that references the rear-most entry in the reorder buffer.

22. The network device of claim 21, wherein the per-entity context memories further include:

a valid bit array associated with each of the reorder buffers, the valid bit array indicating whether entries in the reorder buffer are valid.

23. The network device of claim 18, wherein the network device is a router.

24. The network device of claim 18, wherein the data items comprise portions of a packet.

25. The network device of claim 18, wherein the pipeline stages include:

at least one arbitration stage that determines an active data item and a corresponding processing element; and

an address computation stage that calculates a position of a received data item for a particular one of the processing elements relative to other data items received from the particular processing element based on a sequence number of the data item.

26. The network device of claim 25, wherein the position of the received data item is calculated based on a modulo operation of the sequence number with a size of a reorder buffer of the particular processing element.

27. The network device of claim 25, wherein the pipeline stages further include:

at least one stage configured to update an assembly memory with information identifying a correct order of the data items on a per-processing-element basis.

28. A system for reordering data items comprising:  
means for receiving the data items associated with a plurality of entities;  
and

means for reordering the received data items on a per-entity basis to correspond to a transmitting order of the data items by sequentially processing the data items over a plurality of pipeline stages.

29. The system of claim 28, wherein the stages of the pipeline include:  
means for determining which of the received data items to process based on a transmitting source of the data item.

30. The system of claim 29, wherein the stages of the pipeline include:  
means for calculating a position of a particular one of the data items  
relative to other data items from the same source as the particular one of the  
data items based on a sequence number of the particular one of the data items.

31. The system of claim 30, wherein the stages of the pipeline include:  
means for updating a memory with addresses of the received data items  
in a correct order of the data items on a per-entity basis.